CHI Systems, Inc.
5030 Camino de la Siesta
San Diego, CA 92108
(619) 718-7050
http://www.chiinc.com

Decision Support Toolbox
DSTB

CHI Systems, Inc.
San Diego, CA
Ken Graves-Principal Investigator

SPAWAR-SSC
San Diego, CA
Dr. S.J. McCarthy - Sponsc

What is DSTB?

- Lightweight set of map-based planning, decision support, and execution monitoring services to enhance planning and real-time situation awareness abilities of USMC Commanders and staffs.
- Generates decision support products and appropriate decision alerts for NAIs, TAIs, and DPs developed during Intelligence Preparation of the Battlefield.
- Acts as a “plan prover,” determining whether a particular planned action such as “move from A to B” is both conceptually and physically feasible, with alerts to potential shortfalls.
- Provides hypertime animation of scheme of maneuver for wargaming of courses of action.
- Continual comparison and reasoning about tactical situation in relation to scheme of maneuver, with alerting when scheme of maneuver is threatened.
- “Information Push Agent” which reasons about large quantities of incoming information and alerts user to information of critical interest.

Decision Support Toolbox Capabilities

- Graphically develop a course of action or tactical plan.
- Generate faster than real-time low-fidelity simulation/animation based on tactical plan, to allow the user to wargame a particular course of action.
- Generate terrain analysis graphics based on Digital Terrain Elevation Data (DTED) or user-specification of terrain objects.
  - Severely Restricted Terrain and Restricted Terrain
  - User-definable slope calculations for DTED terrain analysis.
- Generate mobility corridor graphics based on terrain analysis.
- Identify choke points along mobility corridors.
- Perform and graphically display time-distance calculations for tactical unit movement as modified by terrain considerations
  - fastest route point to point
  - fastest route to intercept moving enemy tactical unit
  - fastest route to get within firing range of enemy tactical unit
- Generate line-of-sight overlays for various weapon systems.

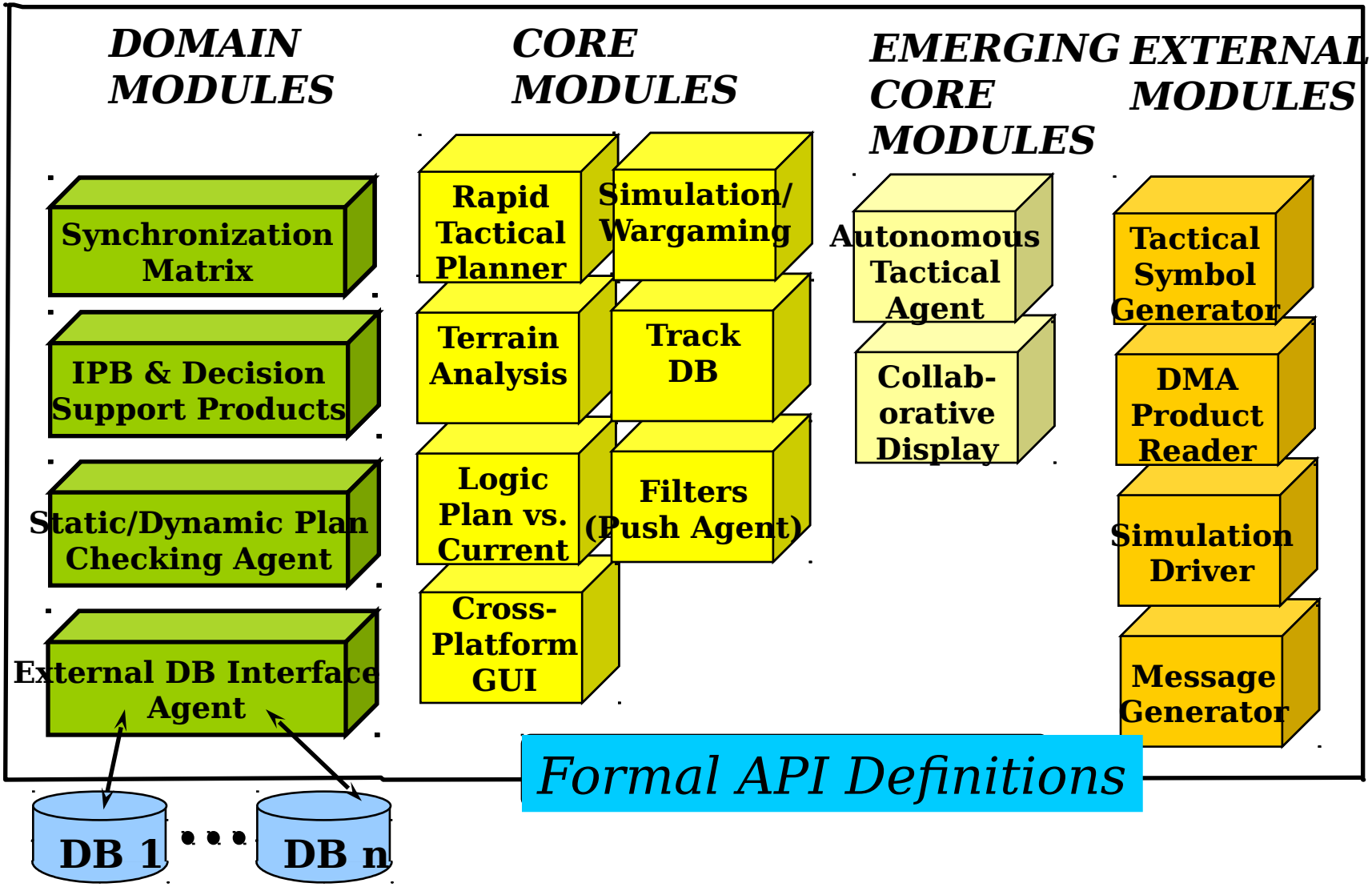
Decision Support Toolbox Capabilities (cont.)

- Generate fuel consumption range overlay for various weapon systems.
- Computer-aided generation of Named and Targeted Areas of Interest (NAIs/TAIs) to support Intelligence Preparation of the Battlefield.
- Correct MIL-STD-2525 Joint Tactical Symbology
- Auto-generation of synchronization matrix for tactical plan, and export to MAGTF Client.
- Generate planning, terrain, mobility, and route overlays and export to other C4I systems via file sharing or electronic mail.
- Ability to monitor track databases of other C4I systems, compare tracks to tactical plan, and provide early alerts to user of deviations from plan.
- Ability to alert user to enemy forces in NAIs or TAIs and allow user to display decisions to be made when NAI or TAI is triggered.
- Send all alerts to interested parties via electronic mail.
- Map display allowing use of multiple map windows, arc-digitized raster graphics, and world vector shoreline/WDB II data.

DSTB Software Features

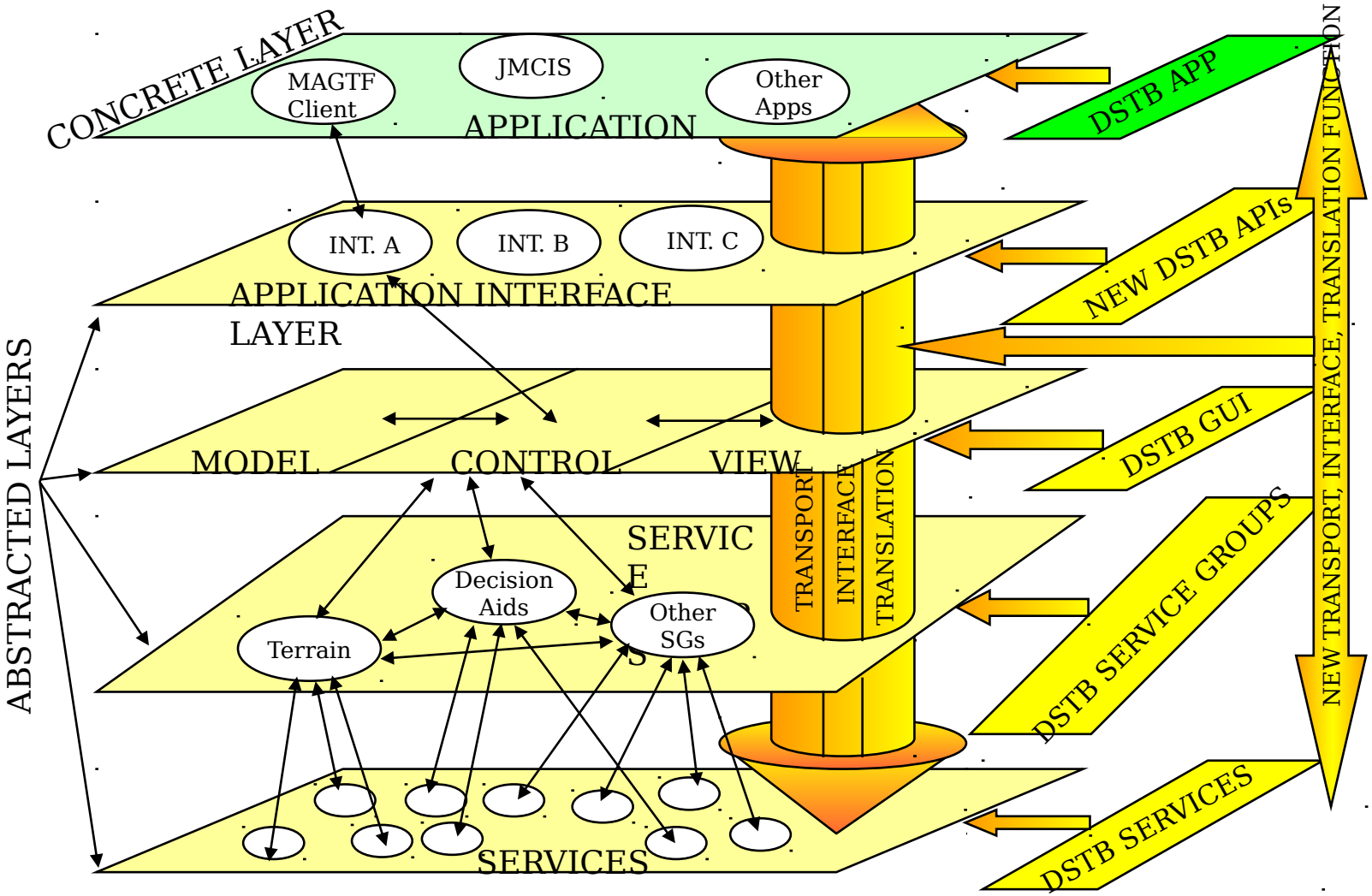
- “Plug and Play” software modules within a service-based software architecture allow the entire application to be used as a standalone, or portions to be used in other visualization/command & control systems.
- Scaleable across echelons
- Completely Object-oriented design; implemented in C++.
- Completely “Point and Click” user interface
- Multiple viewports or map displays
- Level 5 compliant with Defense Information Infrastructure Common Operating Environment (DII COE).
- Clean, well-documented APIs allow easy integration of services.
- Services packaged as Microsoft COM services for Windows NT.
- Cross-platform: SUN, Silicon Graphics, PC-LINUX, and Windows NT.
- On-line User Manual
- Entire DSTB application less than 8 Mb without map data.

DSTB Software Architecture



Decision Support Toolbox

Open Architecture of DSTB Interfaces to Many Applications



Core DSTB Modules and Services

Rapid Tactical Planner

1. Quick laydown of tactical plan
2. Visualization of unit movement
3. Placement of maneuver graphics
4. Attributes for all objects

Simulation/Wargaming

1. Generate simulation message file from plan
2. Allow wargaming of COAs
3. 0-1000 times real time

Terrain Analysis

1. Go, No Go, SlowGo Terrain
2. Mobility Corridor Analysis
3. DTED Line of Sight
4. Unit Movement calculation

Track Database

1. Maintain all data on friendly and enemy units in object oriented DB.
2. Attributes for all track objects
3. Real world and simulation tracks

Core DSTB Modules and Services

Logic (Plan vs. Current)

1. Continuous comparison of tactical situation against plan
2. Alerts when plan threatened by friendly or enemy actions

Push Agent Filters

1. Filter incoming digital info to eliminate non-critical info.
2. Set logic module parameters for alerting

Cross Platform GUI

1. Supports MOTIF, MFCs
2. Native look and feel
3. Allows for eye-voice GUI control

External DSTB Modules and Services

Tactical Symbol Generator

1. Build friendly and enemy unit symbology
2. Symbol is a true object
3. MIL-STD-2525 Joint Symbology

DMA Product Reader

1. Read and display ADRGs
2. Read and display Interim Terrain Data (ITD) for terrain reasoning.

Simulation Driver

1. Separate application to run simulations
2. Reads and sends simulation message to simulation module

Message Generator

1. Two-way parser for message traffic
2. parses incoming message into object
3. translates object into outgoing message

Emerging DSTB Modules and Services

Emerging Modules

Autonomous Tactical Agent

1. **Computer-aided generation of NAIs, TAIs, DPs**
2. **Advanced terrain reasoning**
3. **Generate decision support template**

Collaborative Display

1. **Common tactical picture on multiple displays**
2. **Multiple users can develop and propose changes to plans**
3. **Shared object database**
4. **Synchronous/asynchronous display updates**
5. **Distributive across architectures and platforms**

DSTB Domain Modules and Services

Synchronization Matrix

1. Convert graphical plan into doctrinal synchronization matrix for display or as paper product

Static/Dynamic Plan Checking Agent

1. Determine what is needed to perform a particular tactical operation
2. Identify shortfalls during planning and alert user to shortfalls

External DB Interface Agent

1. Identify locations of data needed by Needs Assessment Agent
2. Obtain and translate data for use in DSTB

IPB & Decision Support Products

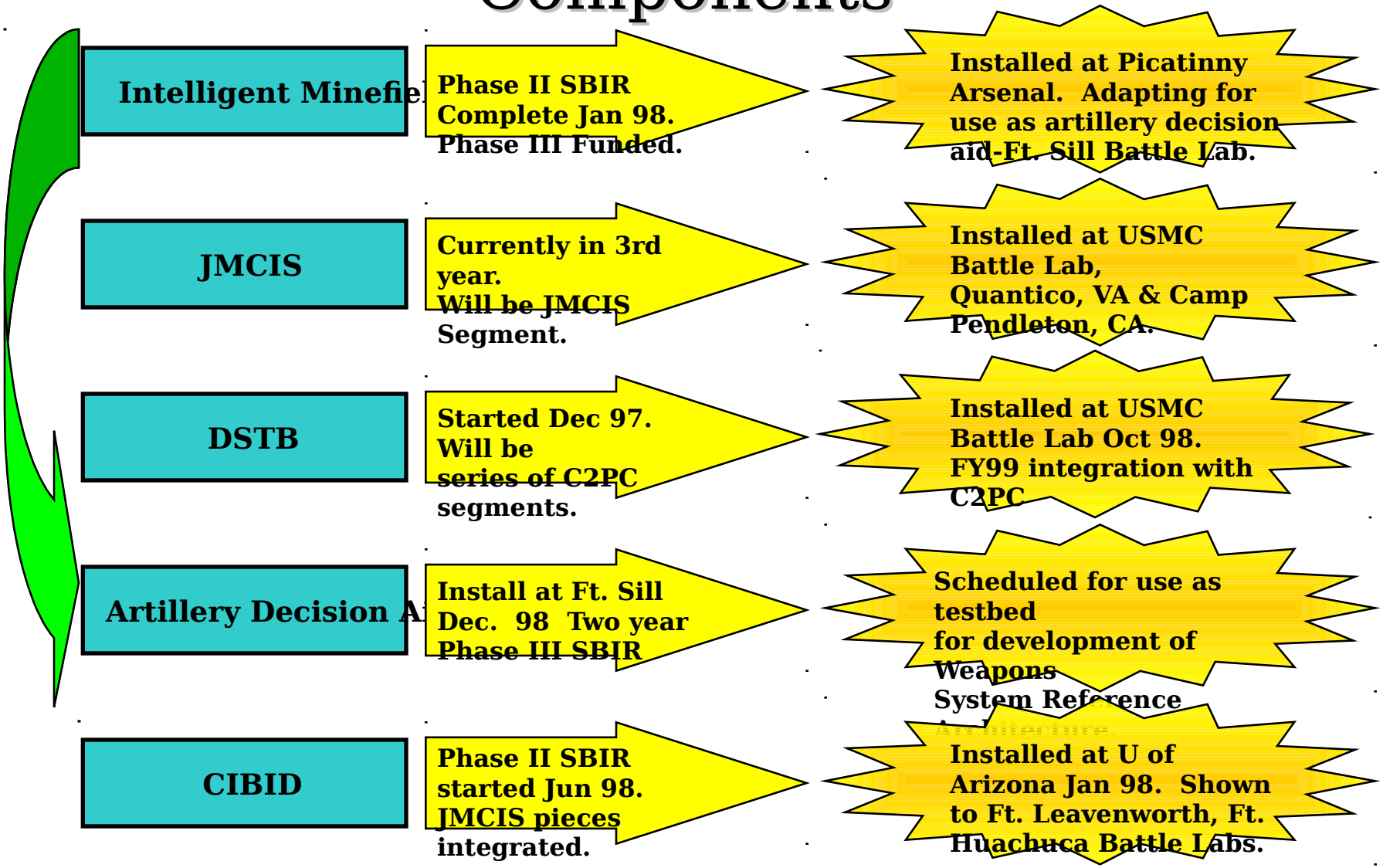
1. Computer-aided generation of NAIs, TAIs, DPs
2. Advanced terrain reasoning/products
3. Generate decision support template

Use of DSTB Services in Other Visualization or Command & Control Systems

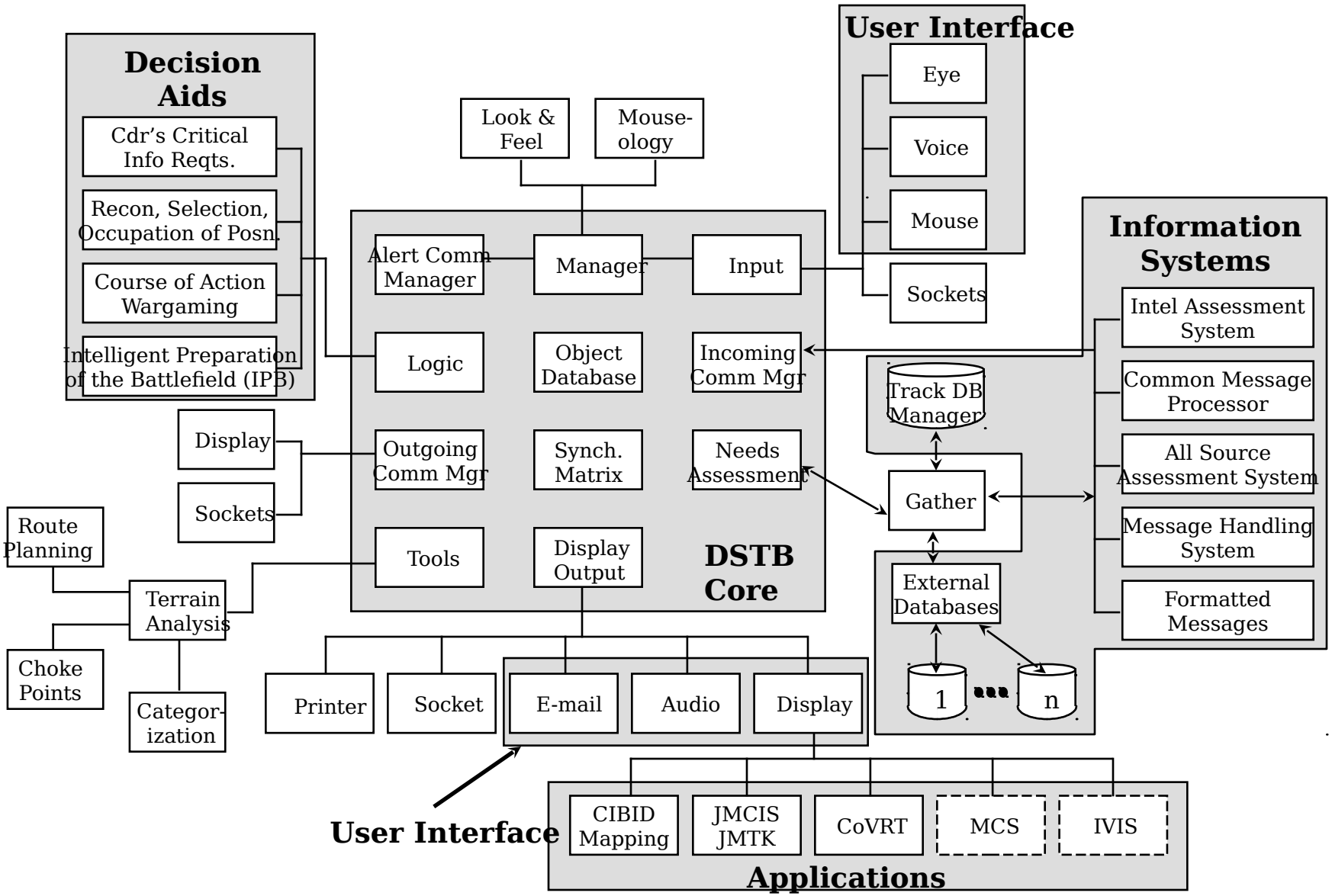
	OTHER VISUALIZATION OR COMMAND & CONTROL SYSTEMS				
KEY SERVICES	Intelligent Minefield	CIBID	Artillery Decision Aid	JMCIS	DSTB
Charting	X	X	API to Map Server	API to Joint Mapping Toolkit	API to Joint Mapping Toolkit
Terrain Analysis	X	X	X	X	X
Rapid Planning	X	X	X	X	X
Logic & Alerting	X	X	X	X	X
Simulation	X	X	TAFSIM API	X	X
Message Parsers	X	X	API to Applique	Uses JMCIS Comms Services	Uses C2PC Comms Services
Object Database	X	X	CORBA wrapper around CHI ODB	CHI Systems ODB or JMCIS TDBM	CHI Systems ODB or C2PC TDBM
Decision Support	X	X	X	X	X
Collaborative Display	None	X	None	None	Pending Funding
Synchronization Matrix	None	X	None	Pending Funding	X
Autonomous Agent	None	X	None	None	Pending Funding

JMCIS: Joint Maritime Command Information System (Current Command & Control system for Navy and USMC
C2PC: Command & Control Personal Computer (developmental WindowsNT client for JMCIS)
CIBID: Commander's Intelligent Battlefield Information Display (ARL-HRED)

Status of Programs using DSTB Components


Intelligent Minefie
Phase II SBIR Complete Jan 98. Phase III Funded.
Installed at Picatinny Arsenal. Adapting for use as artillery decision aid-Ft. Sill Battle Lab.
JMCIS
Currently in 3rd year. Will be JMCIS Segment.
Installed at USMC Battle Lab, Quantico, VA & Camp Pendleton, CA.
DSTB
Started Dec 97. Will be series of C2PC segments.
Installed at USMC Battle Lab Oct 98. FY99 integration with C2PC
Artillery Decision A
Install at Ft. Sill Dec. 98 Two year Phase III SBIR
Scheduled for use as testbed for development of Weapons System Reference
CIBID
Phase II SBIR started Jun 98. JMCIS pieces integrated.
Installed at U of Arizona Jan 98. Shown to Ft. Leavenworth, Ft. Huachuca Battle Labs.

Potential DSTB Interfaces



How DSTB Works With Other C4I Applications (MAGTF Client Example)

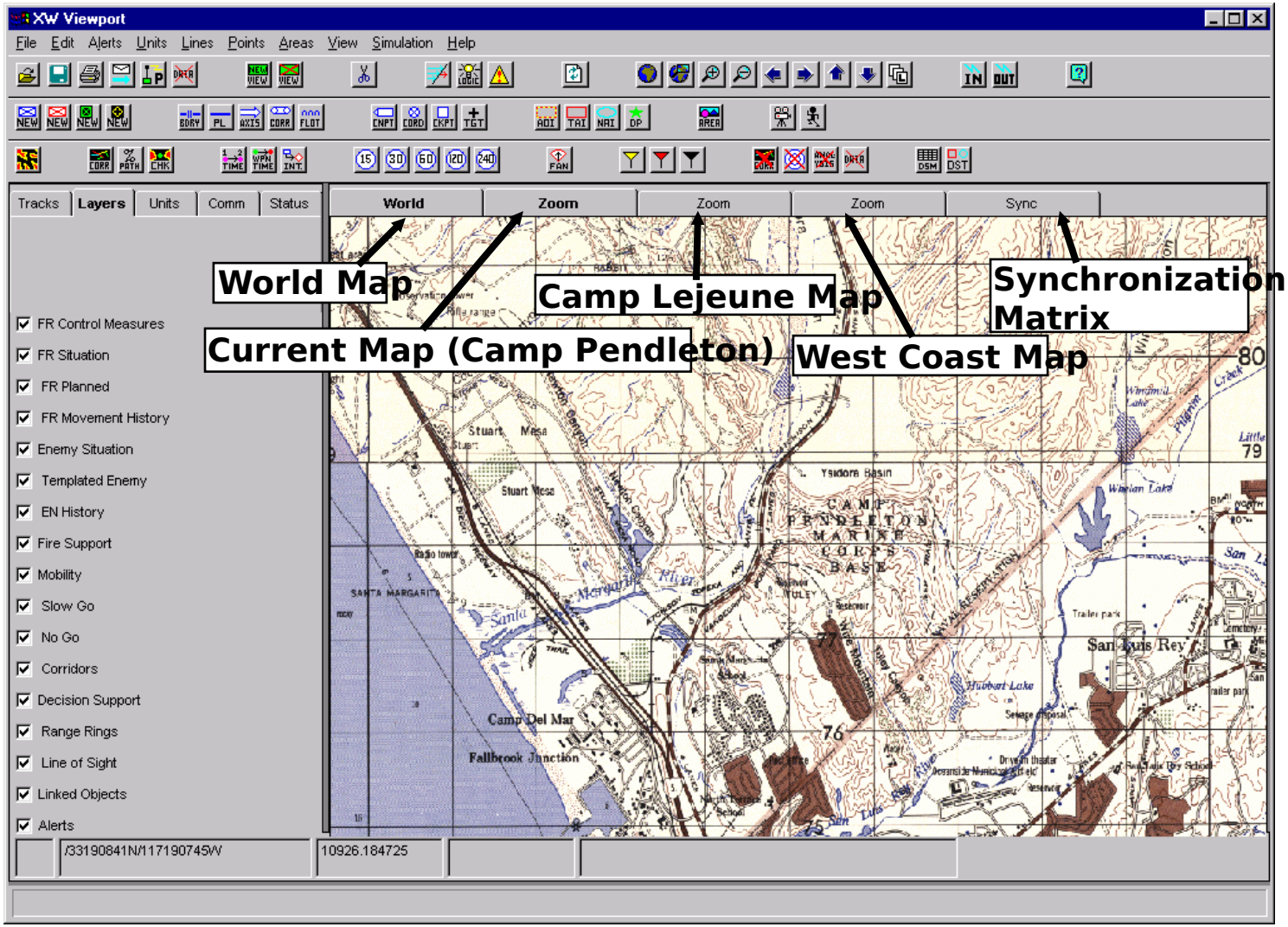
- DSTB and MAGTF Client run simultaneously on the same Windows NT workstation.
- Planners use DSTB to develop and wargame courses of actions and tactical plan.
- During planning process, planner builds decision support products on DSTB and then exports them to MAGTF Client via file sharing.
- Decision support products can also be e-mailed to remote MAGTF client systems.
- For overlay products, MAGTF Client user simply selects the product from the overlay directory and displays it. The overlay can then be manipulated as any overlay generated by MAGTF Client.
- For spreadsheet products, i.e., synchronization matrix, the user imports the product into Microsoft Access or Excel.

Current Exportable DSTB Products

- Overlay Products
  - DTED Terrain Analysis (user-definable slopes)
  - User-defined (manual) Terrain Analysis
  - Named Areas of Interest
  - Targeted Areas of Interest
  - Mobility Corridors
  - Movement Range Rings (based on time traveled over terrain)
  - Weapon Line of Sight
  - Unrefueled Movement Range Ring to 75%, 50%, and 25%fuel expenditure
  - Planned Friendly Unit Routes; Templated Enemy Unit Routes
  - Artillery Targets
  - Maneuver Graphics
- Spreadsheet Products (tab-delimited text files)
  - Synchronization Matrix
  - Decision Support Template (detailed attributes and decisions for NAIs and TAIs)
  - Individual Unit Route and Waypoint Rollup

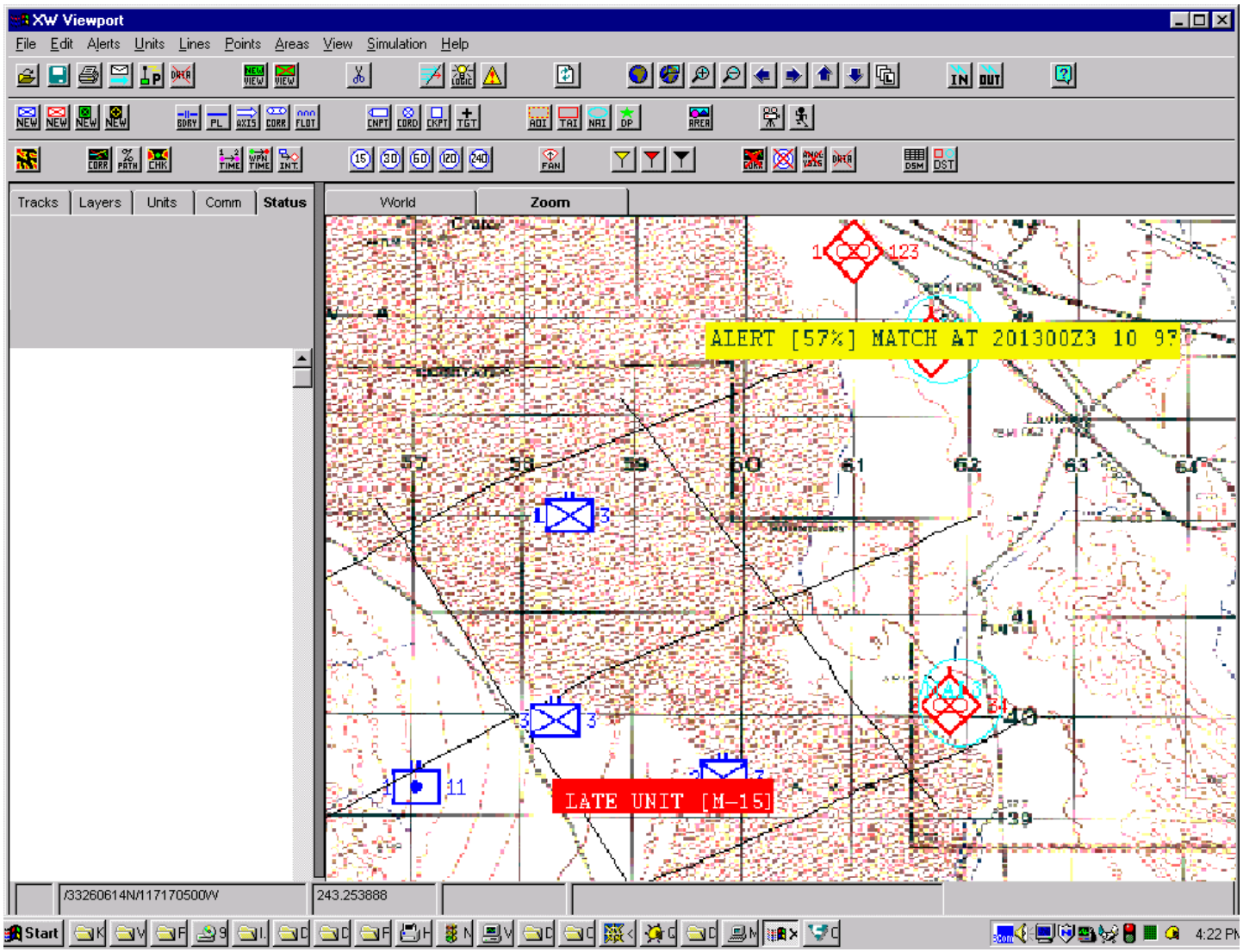
Decision Support Toolbox

Multiple Map Views



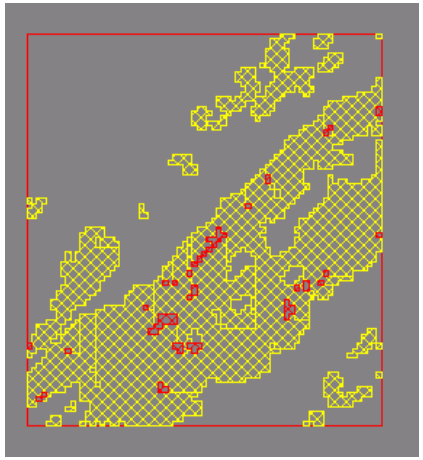
Decision Support Toolbox

Simulation Showing Alerting

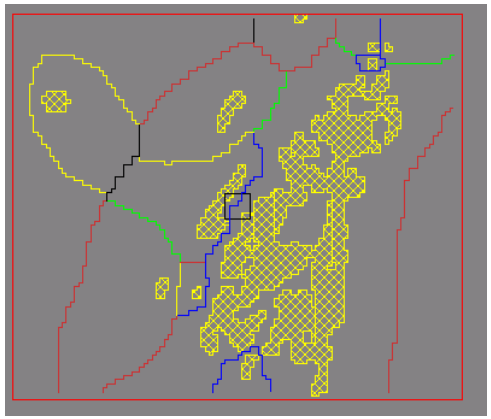


Decision Support Toolbox

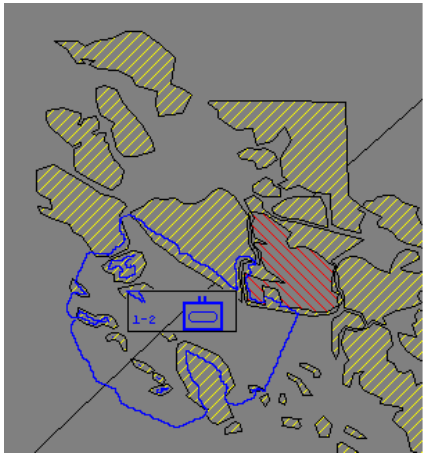
Terrain Analysis and IPB Decision Support



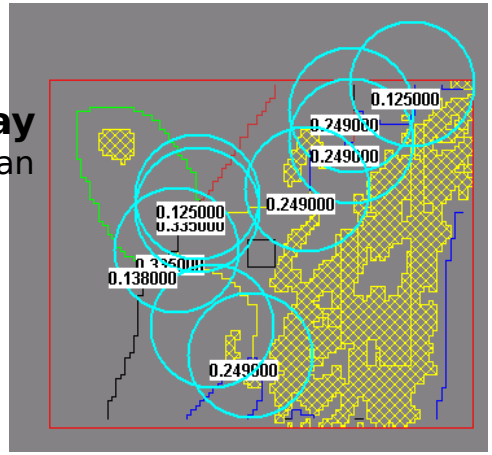
Terrain Analysis Overlay
Yellow = Restricted
Red = Severely Restricted



Mobility Corridors Overlay
Blue = Squad
Yellow = Platoon
Green = Company
Orange = Battalion
Black = Regiment



Range Ring Overlay
Shows where the unit can go in the terrain over a given time (15, 30, 60, 120, and 240 minutes). Uses doctrinal speeds through terrain types.

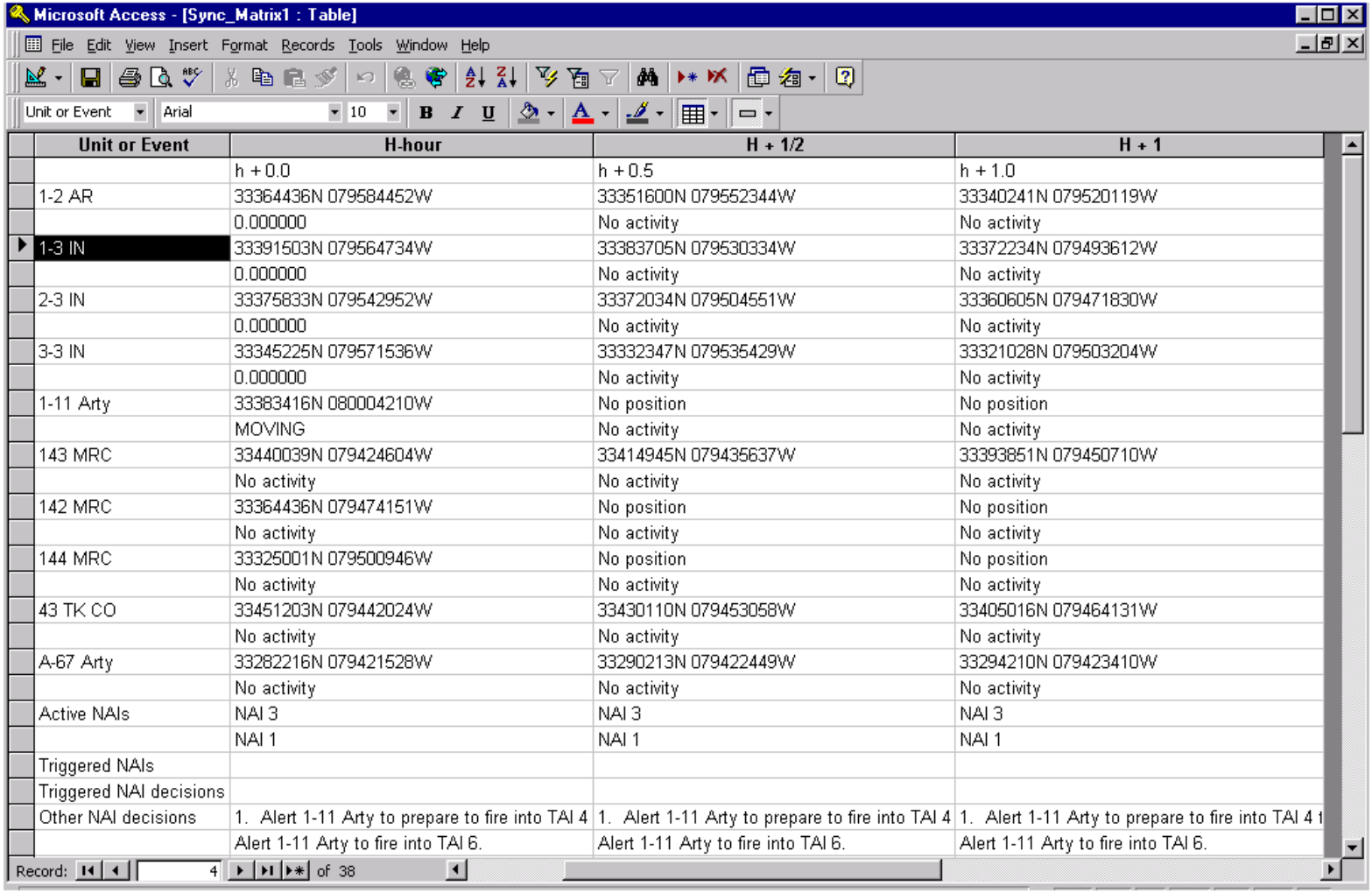


Autogenerate NAIs
Displays 10 most probable locations for NAIs, along with the probability that enemy will enter the NAI. Similar function for TAIs. User can add, remove, or alter NAIs.

NOTE: ADRG Map Not Shown for Clarity.

Decision Support Toolbox

Synchronization Matrix in MS Access



Microsoft Access - [Sync_Matrix1 : Table]

File Edit View Insert Format Records Tools Window Help

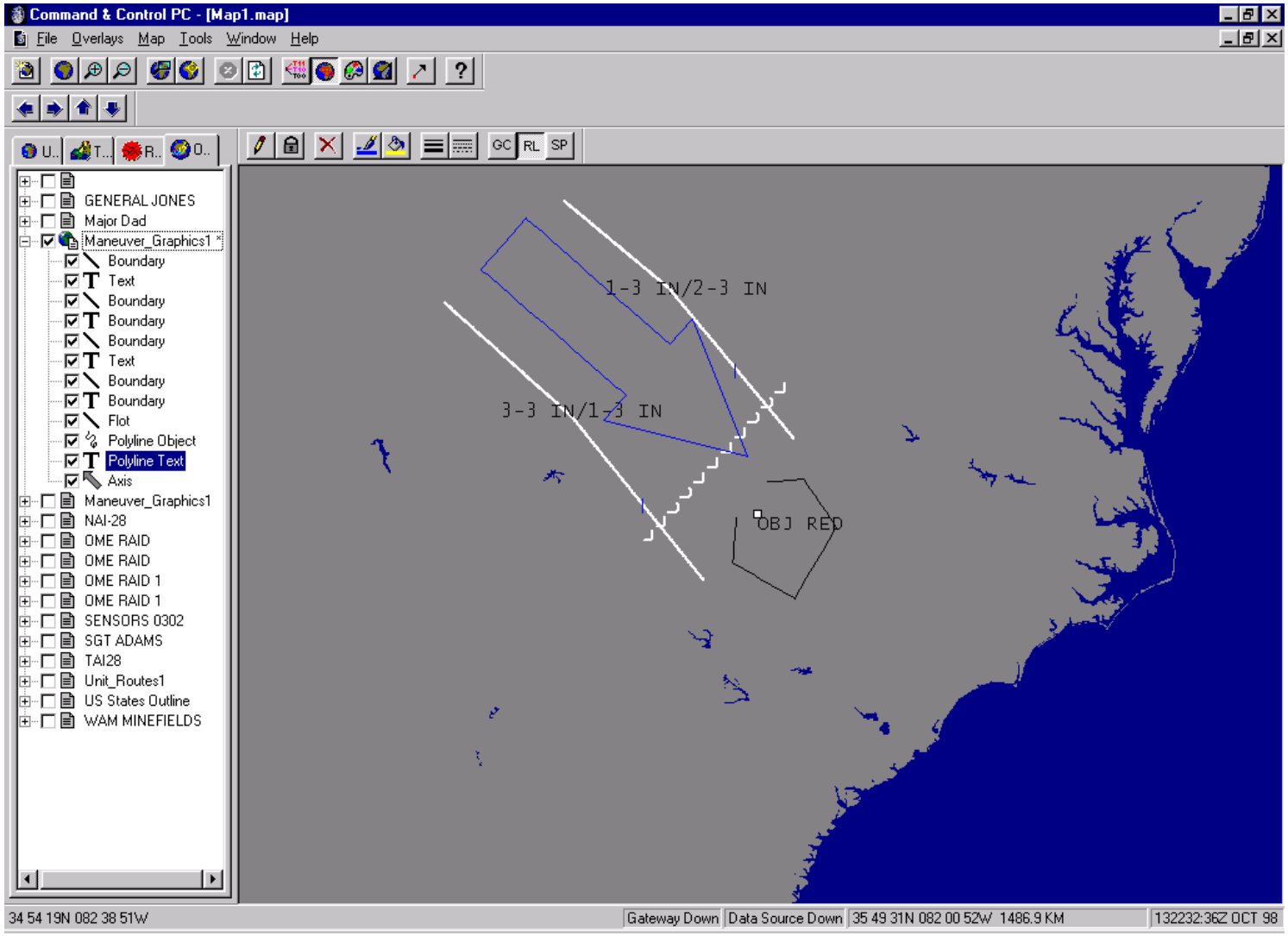
Unit or Event | Arial | 10

Unit or Event	H-hour	H + 1/2	H + 1
	h + 0.0	h + 0.5	h + 1.0
1-2 AR	33364436N 079584452W	33351600N 079552344W	33340241N 079520119W
	0.000000	No activity	No activity
1-3 IN	33391503N 079564734W	33383705N 079530334W	33372234N 079493612W
	0.000000	No activity	No activity
2-3 IN	33375833N 079542952W	33372034N 079504551W	33360605N 079471830W
	0.000000	No activity	No activity
3-3 IN	33345225N 079571536W	33332347N 079535429W	33321028N 079503204W
	0.000000	No activity	No activity
1-11 Arty	33383416N 080004210W	No position	No position
	MOVING	No activity	No activity
143 MRC	33440039N 079424604W	33414945N 079435637W	33393851N 079450710W
	No activity	No activity	No activity
142 MRC	33364436N 079474151W	No position	No position
	No activity	No activity	No activity
144 MRC	33325001N 079500946W	No position	No position
	No activity	No activity	No activity
43 TK CO	33451203N 079442024W	33430110N 079453058W	33405016N 079464131W
	No activity	No activity	No activity
A-67 Arty	33282216N 079421528W	33290213N 079422449W	33294210N 079423410W
	No activity	No activity	No activity
Active NAIs	NAI 3	NAI 3	NAI 3
	NAI 1	NAI 1	NAI 1
Triggered NAIs			
Triggered NAI decisions			
Other NAI decisions	1. Alert 1-11 Arty to prepare to fire into TAI 4	1. Alert 1-11 Arty to prepare to fire into TAI 4	1. Alert 1-11 Arty to prepare to fire into TAI 4 t
	Alert 1-11 Arty to fire into TAI 6.	Alert 1-11 Arty to fire into TAI 6.	Alert 1-11 Arty to fire into TAI 6.

Record: 4 of 38

Decision Support Toolbox

Simple DSTB Maneuver Graphics Overlay Imported to MAGTF Clien



Decision Support Toolbox

Feedback from MSTP Battle Staff Training Facility (28-30 Sept 1998

- The software is well documented and intuitively easy to use.
- BSTF has asked the Marine Topographic Engineers for the same terrain analysis products for the last 6 months with no result- DSTB provides everything they were asking for and more.
- The DSTB software is a big step in developing products for Intelligence Preparation of the Battlefield.
- BSTF wants the terrain products right now; in fact, they asked if we could perform a terrain analysis of Tunisia for an upcoming exercise.
- BSTF thinks that the user-defined parameters for slope calculations in DTED terrain analysis are a must have item. DSTB has it. This particular capability made a big hit with BSTF.
- BSTF really liked the ability to instantly jump back and forth between different map tabs showing different areas of the world with different combinations of ADRG maps, graphics, and overlays on each tab.

Decision Support Toolbox

Feedback from MSTP Battle Staff Training Facility (28-30 Sept 1998

- Autogeneration of the synchronization matrix from a graphical plan is a big step forward.
- They like the ability to query numerous properties of tactical units such as maximum weapons range, unrefueled travel range, maximum road speed, etc.
- They like the various alerting capabilities of DSTB.
- They like the capability to autogenerate TAIs and NAIs.
- They appeared to be amazed that we were able to faithfully reproduce the DSTB decision support products (overlays) on the MAGTF Client display.
- BSTF liked the electronic user manual which provides on-line, context-sensitive help.
- BSTF Commander wants to put DSTB into MAGTF Client ASAP.

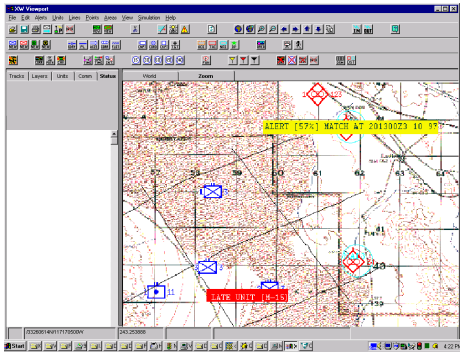
Decision Support Toolbox

Continuing Development

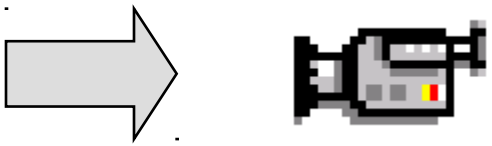
- Ongoing effort to have Marine Corps Tactical Software Support Agency (MCTSSA) evaluate a mechanism to incorporate or integrate DSTB functionality directly into the MAGTF Client application as a segment.
- Development of autonomous tactical agent factory to allow course of action wargaming against intelligent enemy forces.
- Static Plan Checking - ensures all units have been arrayed and used in course of action.
- Dynamic Plan Checking - checks for physical feasibility of plan
  - logistics
  - terrain
  - combat power
  - time constraints
- Web-based distribution of course of action simulation results via video screen capture.

Decision Support Toolbox

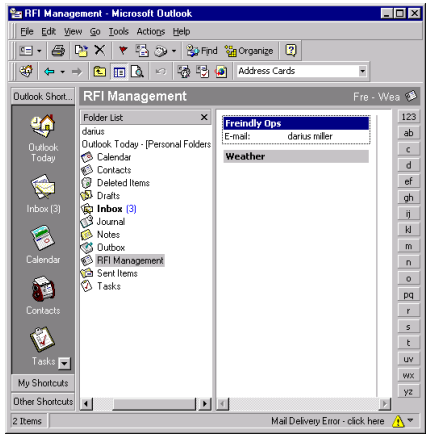
Course of Action Simulation Broadcast as Video to Multiple Player



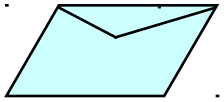
1. High speed COA simulation run at workstation running DSTB.

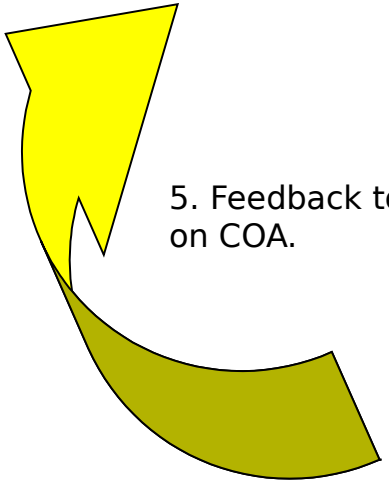


2. Video Capture and MPEG or fractal video compression of simulation.



3. Post as streaming video on MS Outlook or e-mail simulation video file to other planners.





5. Feedback to Planners on COA.

4. View Simulation video with Media Player or Real Video.

Dynamic Plan Checking

Task: Move Battalion from Point A to Point B.

Conceptual Path (Backward Chain of Info Needs to Data)	Physical Path (External Search for Data Meeting Info Needs)	Compare Physical to Conceptual Path (Forward Chain Data into Info)
Terrain Info Needs	**Terrain Data**	**Terrain Info**
•Mobility Corridors from A to B	•Identify feasible mobility corridors	Match | No Match
•Roads between A and B	•Identify roads	Match | No Match
•Bridges between A and B	•Identify Bridges between A and B	Match | No Match
•Distance from A to B	•Calculate Distance from A to B	Match | No Match
Logistics Info Needs	**Logistics Data**	**Logistics Info**
•Need for Heavy Equip. Transport	•Identify available Heavy Equip. Transport	Match | No Match
•Class III Requirement	•Class III Available	Match | No Match
•Wheeled Vehicles to be moved	•Number of Wheeled Vehicles to be moved	Match | No Match
•Tracked Vehicles to be moved	•Number of Tracked Vehicles to be moved	Match | No Match
•Personnel to be moved	•Number of Personnel to be moved	Match | No Match
•Equipment to be moved	•Number of Equipment to be moved	Match | No Match
•Supplies to be moved	•Quantity of Supplies to be moved	Match | No Match
•Required Maintenance Status	•Current Maintenance Status	Match | No Match

Alert: Bridge Blown

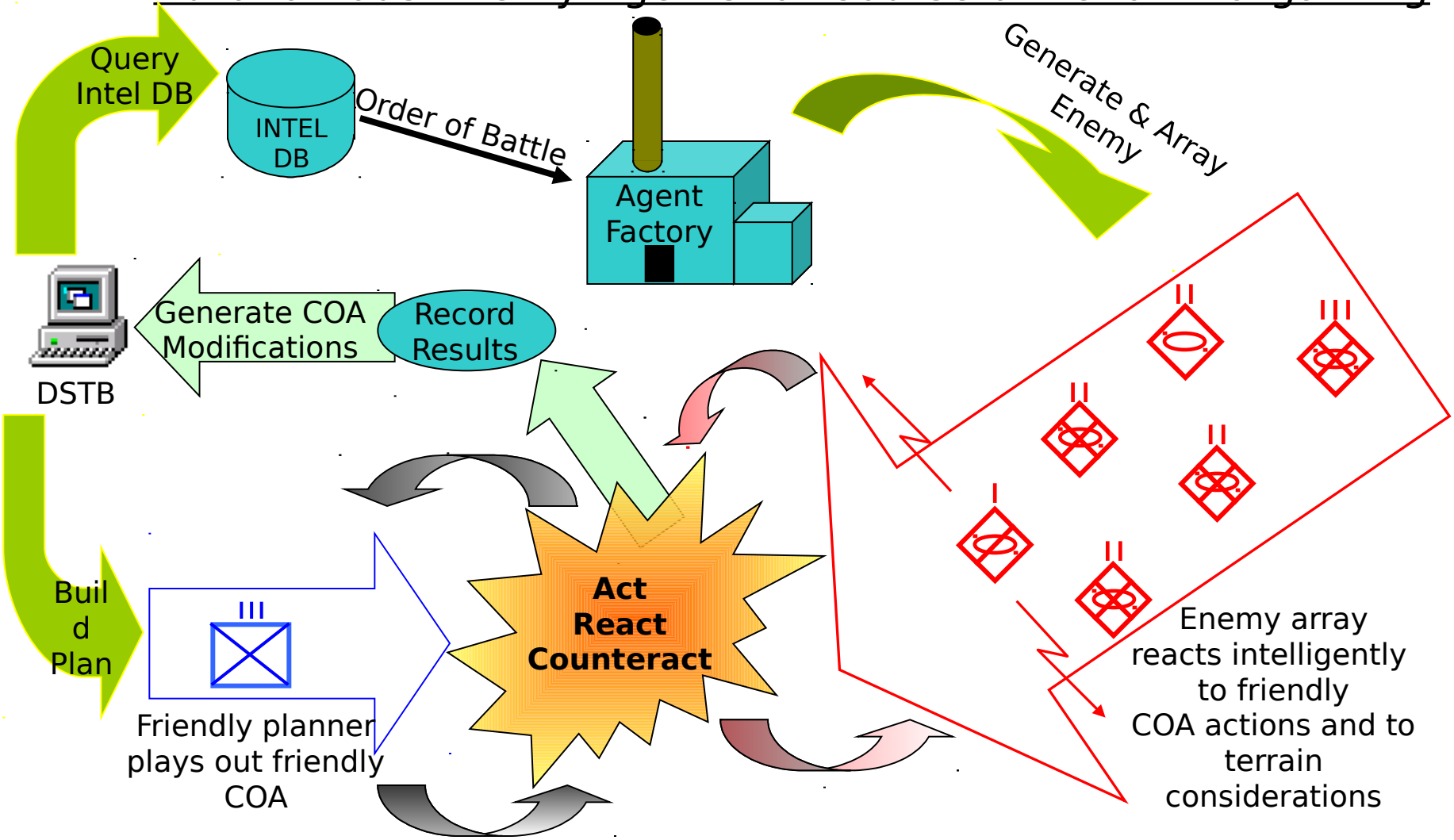
Decompose Info Requirement to Data Need

Search for Data Matching Data Needs

Recompose Data to Info; Compare to Original Info Reqt

Decision Support Toolbox

Autonomous Enemy Agents for Course of Action Wargaming



How DSTB Can Work With USAF C4I Needs

- Autogeneration of TAIs/NAIs for Battlefield Air Interdiction (BAI) targeting and planning, and for development of sensor management plans.
- Alerts for enemy entry into NAIs/TAIs/Decision Points for allocation of attack assets at the appropriate time and place.
- Use of terrain analysis products for low-level flight routes, identification of critical movement choke points, etc.
- Weapons line of sight for avoidance of enemy AAA.
- Coordination of air attack with ground forces via synchronization matrix.
- Course of Action Wargaming to identify high probability enemy courses of action and force concentrations for targeting.